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STATUS-REPORT on WLRS

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Abstract

The Status-Report of WLRS gives an overview of its set up and the developments necessary to make the system operational.

1 History

After setting up the new Wettzell laser ranging system WLRS in the year 1989 the system got its first successful returns from LAGEOS at 29th January, 1990 (see table 1). As these returns were not calibrated they were only of "engineering use". The system showed that it was able to track to Etalon-type satellites and to METEOSAT P2. Before the first attempts to the moon were started the system was set up to a reliable and calibrated state. In order to guarantee continous observations from Wettzell a co-location between SRS and WLRS has been carried out. The old SRS-system is now replaced by WLRS.

At the beginning of 1991 WLRS started to track on a routine basis to the satellites LAGEOS, ETALON-1 and ETALON-2. During the first six month of year 1991 the WLRS-System was operated by one shift mostly during night times. Since 1st July 1991 there were enough educated observers to track 24 hours a day. This can clearly be seen in the amount of observed passes (see table 1). The number of returns per LAGEOS-pass ranged from several hundred up to 6000. At the end of 1991 the operators had enough experiences to track AJISAI, STARLETTE and ERS-1 satellites.

The first (calibrated) measurements from the moon were obtained in July 1991. In November 1991 a series of 52 echos from the moon could be measured, which resulted in one normalpoint.

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Jan., 29th, 1990	First echos from LAGEOS
Feb., 21st, 1990	First echos from ETALON-2
Feb., 23rd, 190	First echos from METEOSAT P2
Oct., 1990	First echos from APOLLO-15 reflector
Oct.1990 - Jan.1991	Collocation between SRS and WLRS
Feb.1991 - Jul.1991	Operational tracking system to LAGEOS, ETALON-1 and ETALON-2 during night time.
Jul.1991 - today:	Operational tracking system to *all* satellites and to the moon on 24 hours per day.

Table 1: Highlights of setting up WLRS

Month	Lunar	LAG	E-1	E-2	AJI	STARL	ERS1	sum
01'91	-	19	-	4	-	-	-	23
02'91	-	4	-	1	-	-	-	5
03'91	-	2	3	2	-	-	-	7
04'91	-	7	10	7	-	-	-	24
05'91	-	4	9	4	-	-	-	17
06'91	-	13	7	16	-	-	-	36
07'91	1	57	26	19	-	-	-	102
08'91	-	64	33	27	-	-	1	125
09'91	-	49	19	19	-	-	2	89
10'91	-	60	8	17	-	-	-	83
11'91	1	18	9	6	-	-	-	33
12'91	-	22	1	2	-	-	-	25
01'92	-	30	1	3	14	-	-	46
02'92	-	32	8	7	16	-	-	63
03'92	-	39	6	9	29	3	3	86
04'92	-	38	4	6	20	-	4	72

Figure 1: Number of passes during 1991 and 1992 of WLRS.

2 Developments

The following modifications and extension were carried out:

- WLRS is controlled by a HP1000/A900 computer. The observations during 24 hours a day restricted the computation time for non realtime tasks. Therefor the processing capacity was extended by an UNIX-based computer HP9000/835. The A900 and the HP9000 were connected to the local area network (LAN) of the Wettzell station.
- To track low orbiting the realtime software had to be modified:
  - To drive the telescope within its full capability under computer control the telescope driving process needed to be replaced.
  - An algorithm was written to drive the telescope "smoothly" into a pass which already has passed the tracking horizon.

- The transmit/receive switch between outgoing and receiving laser pulses is realized as a rotating mirror with two holes. To fire the laser with 10 Hz the mirror must rotate with 5 Hz. To track to low orbiting satellites the software to ramp up and control the rotating frequency of the T/R-switch up to 10 Hz was replaced.
- To track low orbiting satellites a 'time bias' was built into the realtime software. This 'time bias' moves the current epoch for the calculations of azimuth, elevation and range.

- During winter 1991/1992 the analysists of the University of Texas and Bendix found a sudden range bias of about 1.75 m. This was caused by the replacement of an amplifier of MCP.
  The reason was found in the dead time of the detection electronics. The electronic needs about 68 ns to be able to detect the realtime calibration pulse after the detection of the start pulse of the laser. This means that the calibration return must take more than 68 ns to be recorded by the event timer. As the return signal from the calibration retro was very close to 68 ns it was not obvious that the electronic detected the "dead-time" instead of the real calibration echo. Now, the calibration return moved away from this critical region to avoid any collisions.
- The quicklook-data generation was replaced by a normal point generation. An orbit fitting algorithm is used.
- Experiments in 2-color ranging have been carried out by measuring several LAGEOS-passes simultanously in green and infrared [Schreiber et al.].

3 Summary

After setting up WLRS in 1989 some essential modifications were carried out:

- High data acquisition rate (up to 6000 Returns per LAGEOS pass);
- Normalpoint precision of 3 – 5 mm (BEFC);
- A laser ranging system which can track all targets — from ERS-1 to the moon.

4 References

[Schreiber et al.] U. Schreiber, K.H. Haufe, R. Dassing, "Measuring Atmospheric Dispersion With WLRS In Multiple Wavelength Mode", published in this proceedings